

Application of Value Engineering in Commercial Building Projects

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Abstract- The current construction industry conditions have entailed the use of rational method and techniques and research and application of new techniques by utilizing advancements in technology in the field of production as well as in every field. Value Engineering is a proven management technique that can make valuable contributions to value enhancement and cost reduction in construction industry. Value Engineering is one of the most effective techniques known to identify and eliminate unnecessary costs in product design, testing, manufacturing, construction, operations, maintenance, data, procedures and practices. The methodology is composed of three main stages. The first stage is the Pre-Study of the Value Engineering. The purpose of this stage is to plan and organize the value study. Value Engineering is the systematic application of recognized techniques that identify the functions of the product or service, creatively establish the worth of those functions, and provide only the necessary functions to meet the required performance at the lowest overall cost. Value Engineering focuses on accomplishing the required functions at the lowest overall cost. It helps in eliminating or minimizing wastage of material, time, and unnecessary cost, which improves value to the customer. The second stage is the Value Study which is the core of Value Engineering study and it is composed of five phases, the Information phase, Function Analysis Phase, Creative Phase, Evaluation Phase and the Presentation phase. All phases and steps perform sequentially. Such sequence of the methodology is expected to assist in logical and systematic flow of the process to achieve the targets of the VE study. The third stage is the Post Study. The objective during post-study activities is to assure the implementation of the approved value study change recommendations. In this study, how the principles of Value Engineering are applied in construction projects is explained, and by taking case study on commercial building as the sample project, practices of Value Engineering in this project are described.

Keywords – Value Engineering, Functions Analysis, Cost, Quality aspects of a project, Value Analysis.

I. INTRODUCTION

Value Engineering is a systematic study to seek out the best functional balance between the cost, reliability and performance of a project. It can be defined as a systematic interdisciplinary examination of various factors those affect the cost of a project or service in order to devise means of achieving the specified purpose most economically at the reduced standards of quality and reliability. Value engineering is basically a team effort. It aims at promotion of value awareness and raising the level of professional competence and technological excellence in the organization. Value engineering not only aims at cost reduction but also cost effectiveness which in turn enhances the value and provides competitive advantage. Value engineering techniques can be applied wherever cost is proposed or likely to be incurred in terms of money, skills/expertise, energy or other resources. In other words, this will cover practically every area of human activity and value engineering can be considered applicable to all of them. value engineering is applicable to hardware, building or other construction projects and to soft areas, such as manufacturing processes, administrative and management systems, office procedures, books and forms and computer software costs. In case of once through projects such as civil engineering works for example, buildings, highways, water/air/effluent treatment plants, etc and engineering projects such as product design, greater benefits from the application of Value Engineering can be obtained by application of these techniques at the early design stages. Adequate data collection in such studies is essential together with in depth involvement of the agencies dealing with the finance, design, construction and use of the project. A project may require several teams to work simultaneously on different aspects such as, structural design, layout, subsystem services, etc

Value engineering studies in soft areas are those which concern manufacturing processes and administrative procedures. A sequence flow chart of activities and times using standard industrial engineering

techniques is essential. Details of material loss, low yield, wastages, rejection, rework, loss of man/machine hours, etc, together with their costs, are equally essential as part of the data to be collected during the information phase of the value engineering study. [1]

Value engineering results in the increased use of alternative less expensive material, cheaper design, weight reduction, new methods of manufacturing, indigenization, etc, to give the same or better performance, quality and efficiency at a lower overall cost. In order to produce a product or service to be competitive in the open market, the best value is determined by two considerations, namely, function and cost of product. Value of a product or service can be enhanced either by increasing the function or decreasing the cost or both while maintaining the performance quality and reliability. [2]

II. HISTORICAL BACKGROUND

Value Engineering had its origin during World War II, at General Electric, when innovation was required because of material shortages. Some critical materials were difficult to obtain, and a great many of substitutions had to be made. Mr. Harry Erlicker, a vice president, made the observation that many times these changes resulted in lower costs and improved products. This encouraged him to seek an approach to intentionally improve a products value. He assigned Lawrence D. Miles, a staff engineer in 1947, the task of finding a more effective way to improve a product's value. In 1985, the Value Engineering process had gained worldwide acceptance. It spawned an international organization, Society of American Value Engineers International (SAVE Int.), dedicated to its practice, and the certification of competent practitioners. In 1997, SAVE approved a standard for Value Engineering Methodology. [3]

III. LITERATURE REVIEW

Boo Young Chung, Syadaruddin Syachrani, Hyung Seok Jeong, and Young Hoon Kwak, (2009)[4], suggested that applying value engineering in a construction project has proven to be an effective way to save the cost of a project. Different value models have been developed and used in construction projects in the past.

Tae Hyung Kim Hyun Woo Lee, and Seok Woo Hong (2015)[5], concluded that applying a systematic value engineering process can be beneficial to develop cost effective design alternatives. Value Engineering studies specifically targeting for this problem are absent from the field. Thus, the goal of this study is to supplement this knowledge gap by applying a systematic value engineering process to an expansion project on soft ground to demonstrate the benefits of performing value engineering. The value engineering process and design alternatives as applied in this study are expected to serve as a guideline for engineers and decision makers in roadway expansion projects on soft ground.

Sungwoo Moon, A.M. Chideok Ha, and Jinkook Yang (2012)[6], said that value engineering is an effort to increase the value of a system through a creative and organized approach. Idea generation is the most important part in a VE job plan. Although the experts in a value engineering team can evaluate multiple alternatives that can replace the original idea, idea generation is usually on the basis of their knowledge and experience.

IV. APPLICABILITY OF VALUE ENGINEERING

Value methodologies can be applied during any stage of a projects development cycle, although the greatest benefit and resource savings are typically achieved early in development during the conceptual stages. At this point, the basic information of the project is established, but major design and development resources have not yet been committed. The reason this is the best time to apply a value methodology is because the manner in which the basic function of the project is performed has not been established, and alternative ways may be identified and considered. Examples of these applications are:

- Construction projects could benefit by identifying improvements for various project phases: concept development, preliminary design, final design, procurement and construction.
- Manufactured products, whether consumer, industrial, or defence, may be studied with a focus on either the design or manufacturing process of that product. A product may be the subject of a value study at any time during the product's life. A value study can be applied at the onset of the product development to better understand the customer's needs, identify the functions necessary to satisfy those needs, and develop the initial concept. Throughout the design development, value methodology can be used to refine and enhance the concept, based on the latest facts. Even after a product has been introduced and is in production, a Value Study can be

used to further enhance the product and respond to changing customer and economic conditions. A value methodology can be used to either develop new ways to manufacture a product or change an existing process.

- Business systems and processes may also be the subject of Value Studies. Many elements of a business or an organization may be improved through the application of a value methodology. This may be from the development of business plans and organizational studies to improving existing business processes.

Value methodologies may be applied more than once during the life of the project. Early application of a value methodology helps to get the project started in the right direction, and repeated applications help to refine the project's direction based on new or changing information. The later a Value Study is conducted in project development, more likely implementation costs will increase. A value methodology may be applied as a quick response study to address a problem or as an integral part of an overall organizational effort to stimulate innovation and improve performance characteristics. Value methodologies may be used to enhance an organization's quality programs, new product development activities, manufacturing processes, and architectural and engineering design. [7]

V. VALUE ENGINEERING IN CONSTRUCTION

Construction projects are becoming bigger in size and scope. Construction companies are pressured to deliver construction projects at a lower cost while maintaining performance on design functions. The engineers have always tried to reduce the cost of construction without affecting the quality and the functional utility, however their approach was based mainly on the past experience. Keeping costs low with traditional methods has been a common practice to improve competitiveness. Saving money at the same time, providing better value is a concept that everyone emphasizes. Value engineering (VE) is a practice whose goal is, always, to achieve value for money. With the advancement of science and technology, it became comparatively easy to reduce the construction cost, but the concept of functional utility was not given due consideration. Reliability and durability were of little importance. Only in recent past. Engineers and Architects have started taking into consideration these important factors i.e. reliability and durability with functional utility to optimise the cost. This cost of the project is named as functional cost, as the ultimate objective of project planning, construction, management and control is to have its functional utility with durability and reliability of its services at the optimum possible cost.

This subject has got emphasize in last few years whose object is to effect economy, in the cost of construction of project. Value engineering (VE) as such is a systematic application of recognised techniques which identify the function of a product or service; establish a monetary value for the function and provide the necessary function reliable at the lowest overall cost. In civil engineering it is related to minimum cost of project or construction work, without affecting the quality. The projects are generally designed by engineers and constructed by contractor. The responsibility of engineer is to design project in a manner such that it must be economical in minimum cost and maximum output. The job of contractor thereafter is to apply his skill to construct the project in estimated cost or if possible even less than that. [1]

VI. RESEARCH METHODOLOGY

The value methodology is a structured, disciplined procedure aim at improving value. The value engineering study uses a systematic procedure called job plan. The job plan outlines specific techniques to effectively analyze a product or service in order to develop the maximum number of alternatives to achieve the products or services required functions. Adherence to the job plan will better assure maximum benefits while offering greater flexibility.

The VE job plan covers three major periods of activity: Pre-study, the Value study, and Post-study As shown in fig.1. All phases and steps are performed sequentially. As a value study progresses new data and information may cause the study team to return to earlier phases or steps within a phase on an iterative basis. [7]

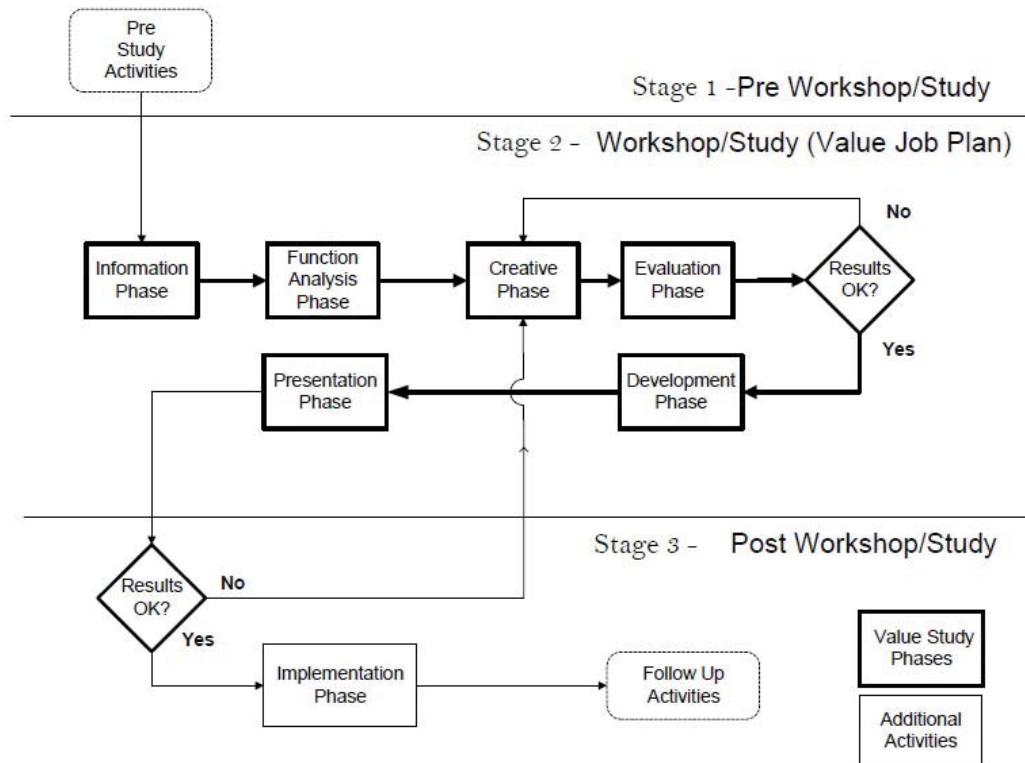


Figure 1 The Job Plan

A. Pre-Study

Pre-study tasks involve six areas: Collect User/Customer Attitudes, Complete Data File, Determine Evaluation Factors, Scope the Study, Build Models, Determine Team Composition. [3]

B. Value Engineering Study

The VE study is composed of six phases: Information, Function, Creativity, Evaluation, Development, and Presentation phase.

1) *Information Phase:* The objective of the information phase is to complete the value study data package started in the pre study work. If not done during the pre study activities, the project sponsor or designer brief the value study team, providing an opportunity for the team to ask questions based on their data research. If a site visit wherever applicable was not possible during pre-study, it should be completed during this phase. [7]

In order to keep this process easy, however, the function of each task must be defined as simply as possible, such as using two verb-noun words. [4]

2) *Function Analysis Phase:* Functional analysis outlines the basic function of a product using a verb and a noun such as 'boil water' as in the case of our kettle. [8].

In function Analysis Phase the team performs: Determine the functions, classify the functions, build a function model, estimate the cost of performing each function, determine the best opportunities for improvement, refine study scope. [3]

3) *Creative Phase:* The Creative Phase develops ideas for alternative ways to perform each function selected for further study. The objective of the creativity phase is to develop a large quantity of ideas for performing each function selected for study. [9]

This is a creative type of effort, totally unconstrained by habit, tradition, negative attitudes, assumed restrictions, and specific criteria. No judgement or discussion occurs during this activity. [3]

4) *Evaluation Phase:* In Evaluation phase alternative ideas are ranked and rated and ideas for development are selected.[8]

The objectives of the evaluation phase are to synthesize ideas and concepts generated in the creativity phase and to select feasible ideas for development into specific value improvement. Using the evaluation criteria established during the pre-study effort, ideas are sorted and rated as to how well they meet those criteria. [3]

5) *Development Phase:* The Development Phase takes the most feasible alternatives and prepares information such as sketches, narratives and specifications to improve the value of the project.[10]

The data package prepared by the champion of each of the alternatives provide as much technical, cost, and schedule information as practical so the designer and project sponsor may make an initial assessment concerning their feasibility for implementation. [7]

6) *Presentation Phase:* The presentation phase is actually presenting the best alternatives to those who have the authority to implement the proposed solutions that are acceptable. [8]

Through the presentation and its interactive discussions, the team obtains either approval to proceed with implementation, or direction for additional information needed. [9]

C. Post-Study

The objective during post-study activities is to assure the implementation of the approved value study change recommendations. Assignments are made either to individuals within the VE study team, or by management to other individuals, to complete the tasks associated with the approved implementation plan. [3]

VII. DATA ANALYSIS

UniFormat for buildings has become a standard in the construction industry because it is based on a building systems level of detail rather than on a trade breakdown. Case study of commercial building has taken to study value engineering application. In this uniformat was prepared. After preparation uniformat costs are distributed in accordance with Pareto's Law 20/80 : a few areas, "the significant few," (generally 20 percent or less) represent most (80 percent or more) of the cost. Conversely, 80 percent of the items, "the insignificant many," represent only 20 percent of total costs Pareto's Law of compares the selected function to the simplest method or product that can be imagined to achieve the same result. As a conclusion, the area of value engineering analysis and study will be controlled based on important uniformat functions. [3]

VIII. CONCLUSION

Value engineering can be applied to a project in a few stages: The first stage is during planning of the plans, specifications and design i.e. prior to release to the contractor. The purpose here is to study various alternatives in planning, designing, specifications, use of local available materials to economise the construction cost wherever possible of course without affecting the quality. The new saving if any shall be the total reduction in cost. The second stage of value engineering study is after the award of the contract of construction works. Here the study is generally made either by the contractor or his value engineer. Here value engineer after studying all details; informs there is any scope for reduction in the cost of the project by adopting certain methods of construction or by changing or modifying design method or by any other legal method maintaining the quality if possible. The application of Pareto Law 20/80 states that around 20 % of the functions constitute around 80% of the cost. These functions are the subject of value engineering. As a conclusion, the area of value engineering analysis and study will be controlled by that functions. Further, we can do analysis of these functions and suggest alternatives and calculate cost model after application of value engineering technique.

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